DoD High Level Architecture Process and Policy

Integrated Training Program

Defense Modeling & Simulation Office
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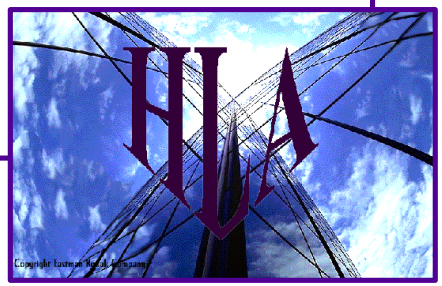
Current as of 01 April 98

Evolution of DoD M&S Strategy



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M&S Critical to DoD's Ability to Meet its Mission

Continuing squeeze on DoD resources

- Shrinking, dispersed force structure
- Competition for O&M funds limits field exercises
- Need to carefully examine every investment

More demanding operational requirements

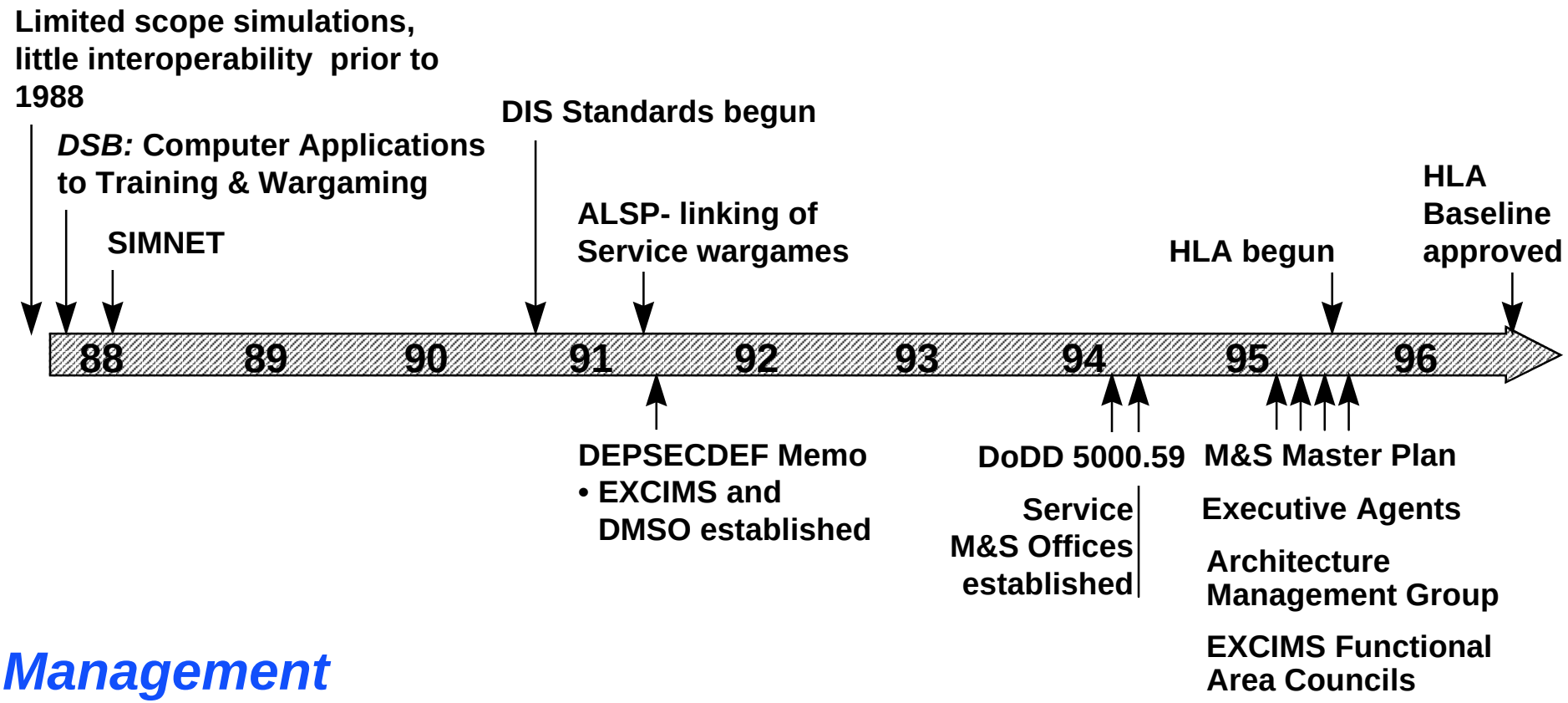
- New, more complex missions
- Vastly expanding mission space
- Increased complexity of systems and plans
- Increasing demand for joint training
- Security challenges (e.g., information warfare)
- No traditional way to address

Much more technical capability at less cost

- Communications
- Computers
- Advanced software technology
- Displays/human-machine interfaces
- Data storage and management

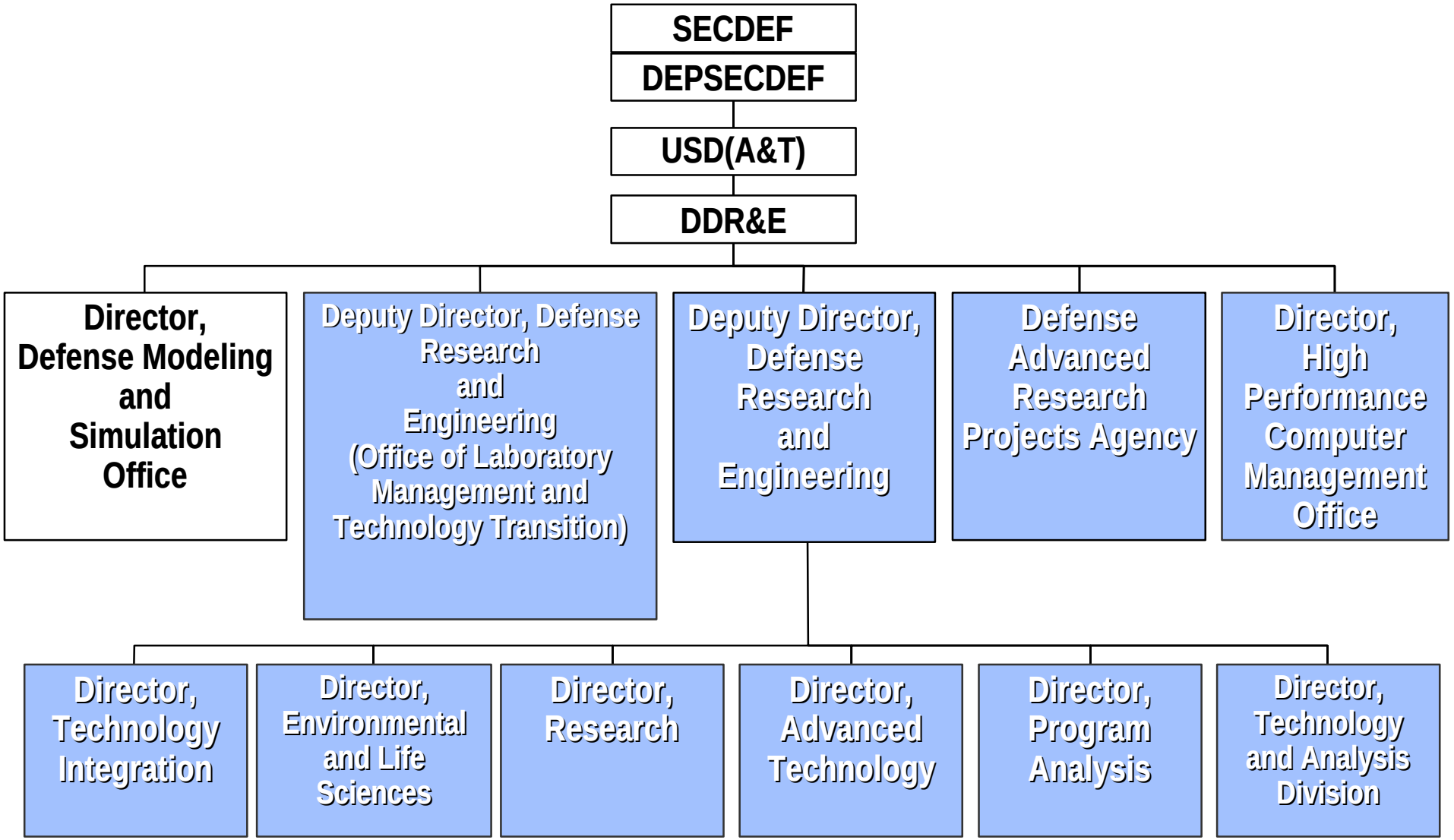
How Did We Get Here?

Technical

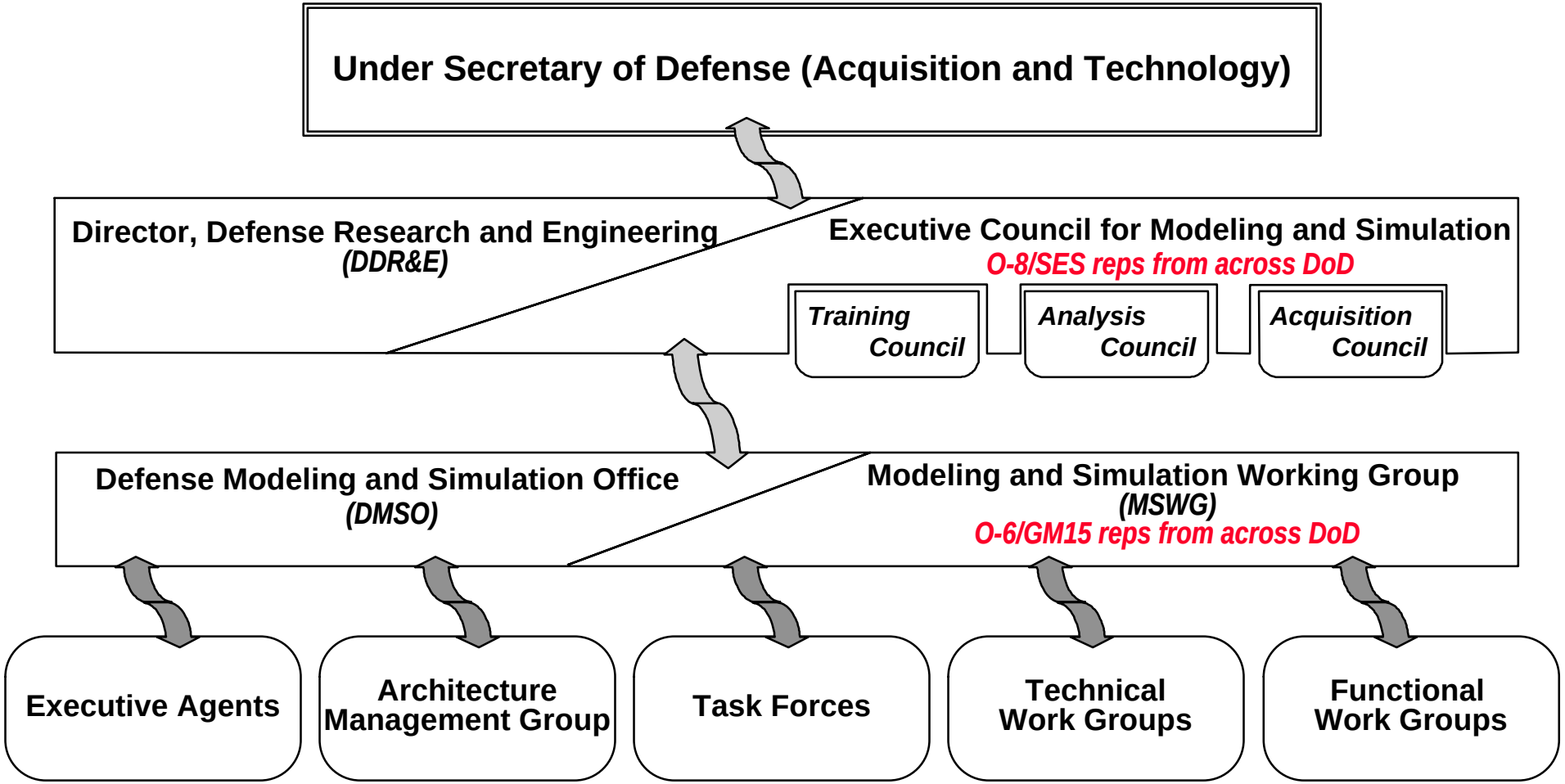


Management

OSD S&T Organization



DoD M&S Management Structure



DoD M&S Vision

- **Defense modeling and simulation will provide readily-available, operationally-valid environments for use by DoD components**
  - **To train jointly, develop doctrine and tactics, Formulate operational plans, and assess war fighting situations**
  - **As well as to support technology assessment, system upgrade, prototype and full scale development, and force structuring**
- **Furthermore, common use of these environments will promote a closer interaction between the operations and acquisition communities in carrying out their respective responsibilities. To allow maximum utility and flexibility, these modeling and simulation environments will be constructed from affordable, reusable components interoperating through an open systems architecture.**

DoD Executive Council on Modeling and Simulation (EXCIMS), March 13, 1992

DoD M&S Master Plan
Objective 1-1

- **Objective 1-1**
- **Establish a common high-level simulation architecture to facilitate the interoperability of all types of models and simulations among themselves and with C4I systems, as well as to facilitate the reuse of M&S components**
- **Simulations developed for particular DoD Components or Functional Areas must conform to the High Level Architecture**
  - **Further definition and detailed implementation of specific simulation system architectures remain the responsibility of the developing Component**

The Common Technical Framework, and specifically the High Level Architecture, represents the highest priority effort within the DoD modeling and simulation community

DoD HLA Policy

- **DoD Policy:**

"Under the authority of [DoD Directive 5000.59], and as prescribed by [the DoD Modeling and Simulation Master Plan], I designate the High Level Architecture as the standard technical architecture for all DoD simulations."

- **HLA supersedes Distributed Interactive Simulation (DIS) and ALSP**
- **"No Can" Dates**
  - **"No Can Pay"- first day of FY99**
    - **No funds for developing/modifying non-HLA-compliant simulations**
  - **"No Can Play"- first day of FY01**
    - **Retirement of non-HLA-compliant simulations**
- **Waivers must be decided on a corporate basis**

Dr. Paul Kaminski, USD(A&T)
10 September 1996

Why HLA Now?

- **DoD M&S Vision**
  - **“ ...common use of these environments will promote a closer interaction between the operations and acquisition communities in carrying out their respective responsibilities. To allow maximum utility and flexibility, these modeling and simulation environments will be constructed from affordable, reusable components interoperating through an open systems architecture.”**
  - **DoD embarking on development of new generation of simulations**
- **Current technology does not provide tools necessary to achieve DoD M&S Vision (i.e., ALSP and DIS)**

How HLA Will Extend DIS and ALSP Capabilities

HLA vs. DIS capabilities:

- HLA applies to multiple time management schemes
  - DIS applies to only real-time, platform level niche of M&S market
- HLA separates data from architecture-- evolves data as required by applications
  - DIS embeds data in architecture causing protocols to be inflexible and ineffective
- HLA selectively passes data among simulations
  - DIS uses full broadcast distribution approach
    - Does not scale from a network or processor viewpoint
- HLA is built around simulation services that DIS does not possess

HLA vs. ALSP capabilities:

- HLA applies to multiple time management schemes
  - ALSP applies to only discrete-event, logical-time niche of M&S market
- HLA new, more robust approach designed in from onset
  - ALSP designed to accommodate legacy simulations
- HLA supports broad DoD user community
  - ALSP evolution driven by Joint Training Confederation (JTC) needs

Basic Overview of the High Level Architecture

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What is the High Level Architecture?

- **The High Level Architecture is comprised of three elements:**
  - **Interface Specification**
  - **Object Model Template (OMT) Specification**
  - **HLA Rules for Federates and Federations**
- **These three elements commonly applicable across all DoD simulations, provide a common framework within which specific system architectures can be defined.**

DoD Policy:

" Under the authority of [DoD Directive 5000.59], and as prescribed by [the DoD Modeling and Simulation Master Plan], I designate the High Level Architecture as the standard technical architecture for all DoD simulations."

Dr. Paul Kaminski
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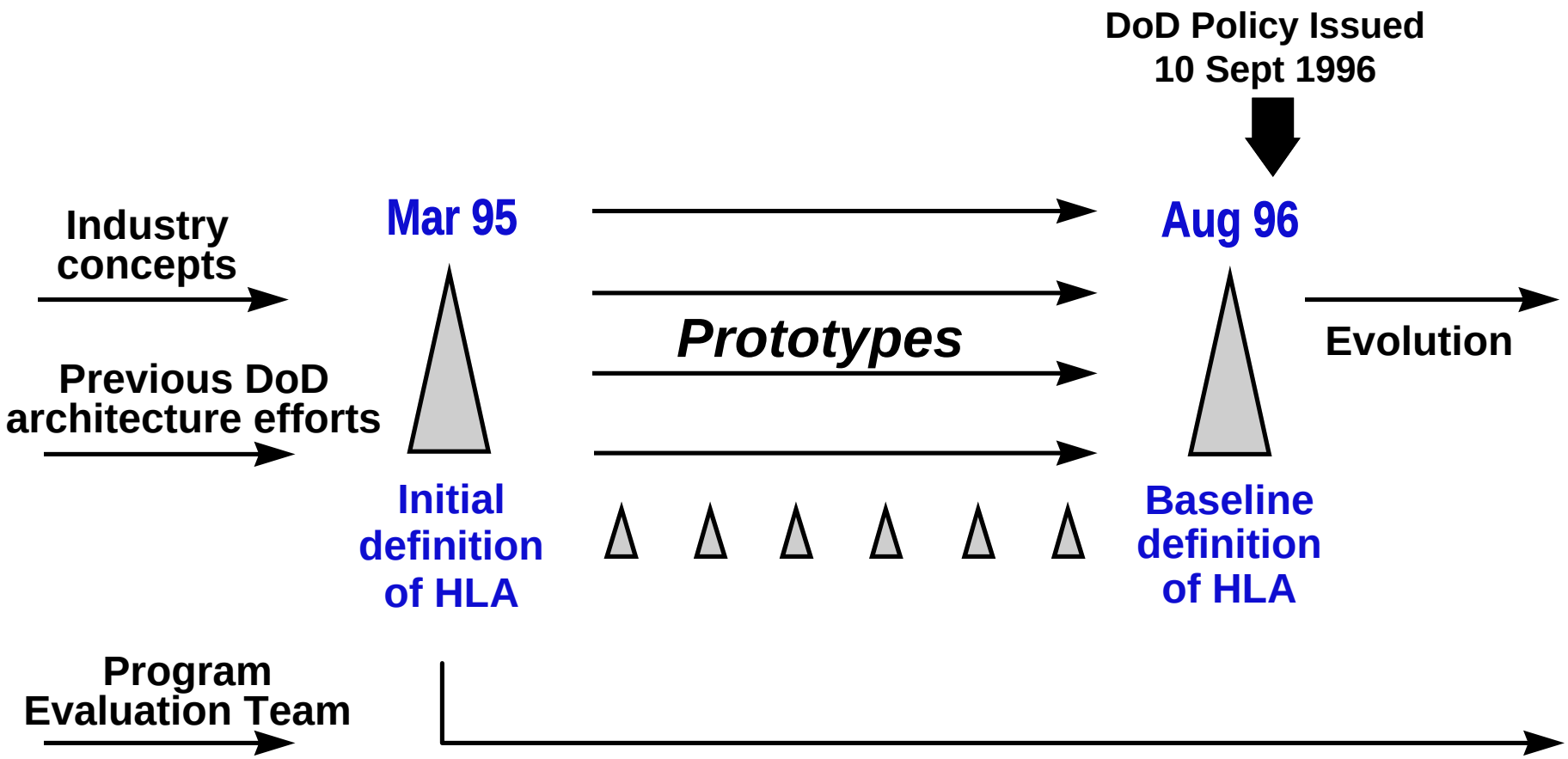
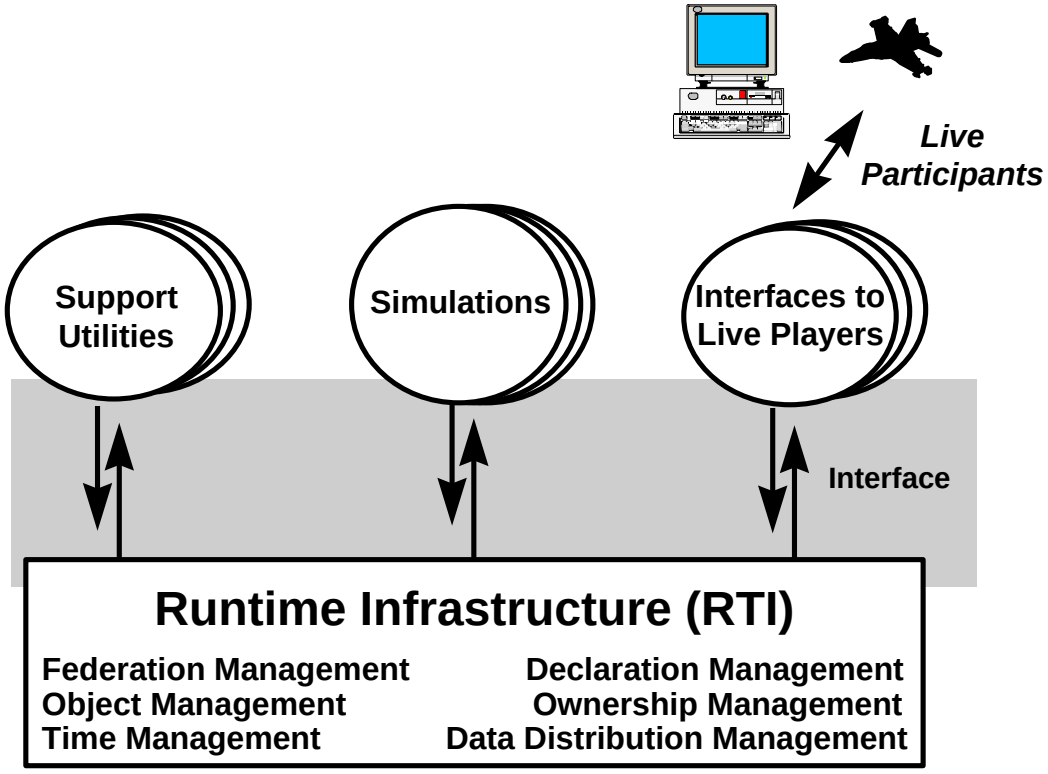
HLA Development Process Overview



DoD-wide Architecture Management Group
(16 major simulation programs; developers were 48% industry, 35% government, 12% FFRDC, 5% academia)

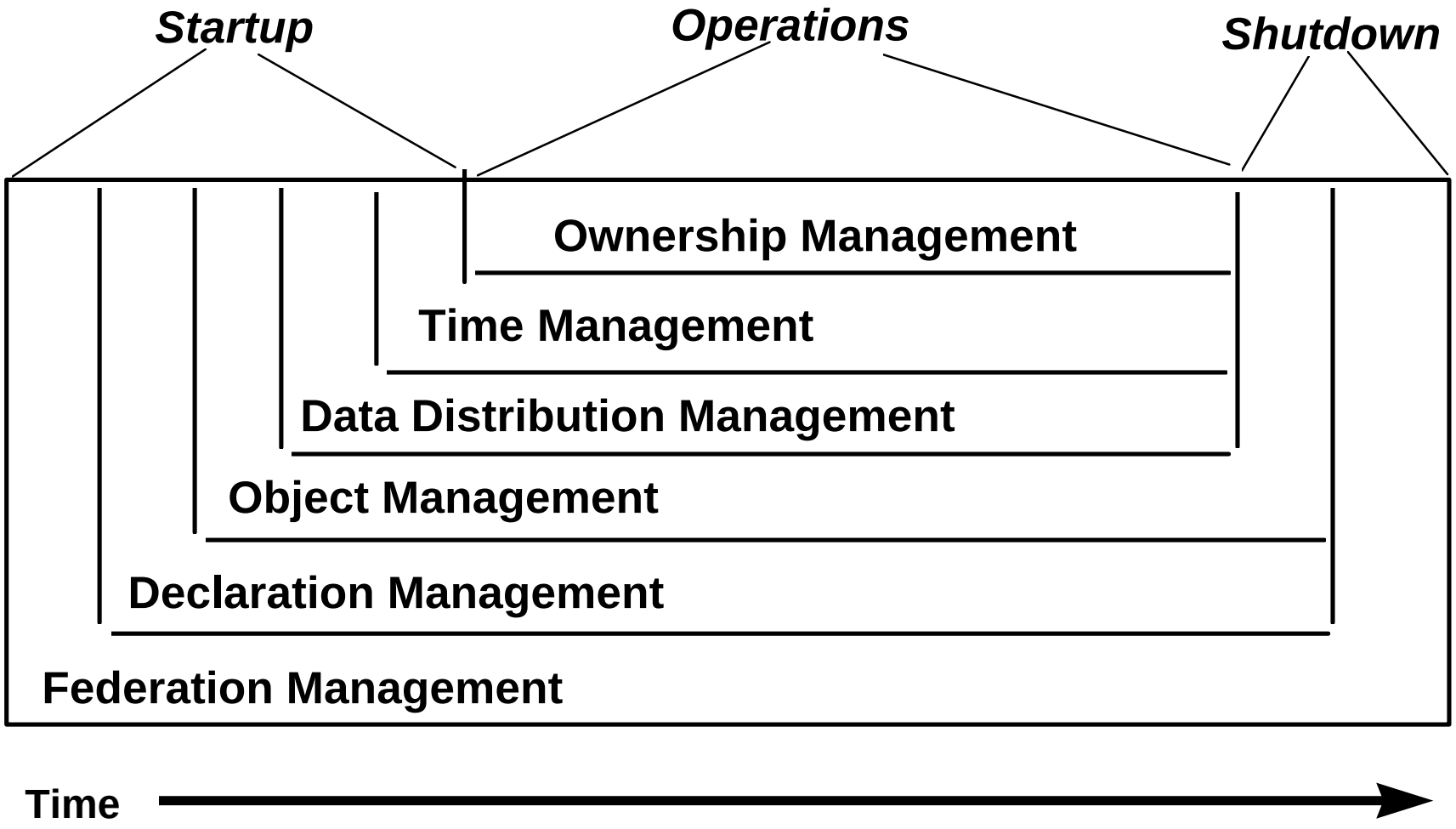
The High Level Architecture (HLA)

- Architecture calls for a federation of simulations
- Architecture specifies
  - Ten Rules which define relationships among federation components
  - An Object Model Template which specifies the form in which simulation elements are described
  - An Interface Specification which describes the way simulations interact during operation



The HLA is not the RTI; the HLA says there will be an RTI that meets HLA requirements but it doesn't specify a particular software implementation

HLA RTI Services over the Life of a Federation



HLA Object Models and OMT

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- **Federation Object Model (FOM)**
  - A description of all shared information (objects, attributes, and interactions) essential to a particular federation
- **Simulation Object Model (SOM)**
  - Describes objects, attributes and interactions in a particular simulation which *can* be used externally in a federation
- **Object Model Template (OMT)**
  - Provides a common framework for HLA object model documentation
  - Fosters interoperability and reuse of simulations via the specification of a common representational framework

Implementing the High Level Architecture

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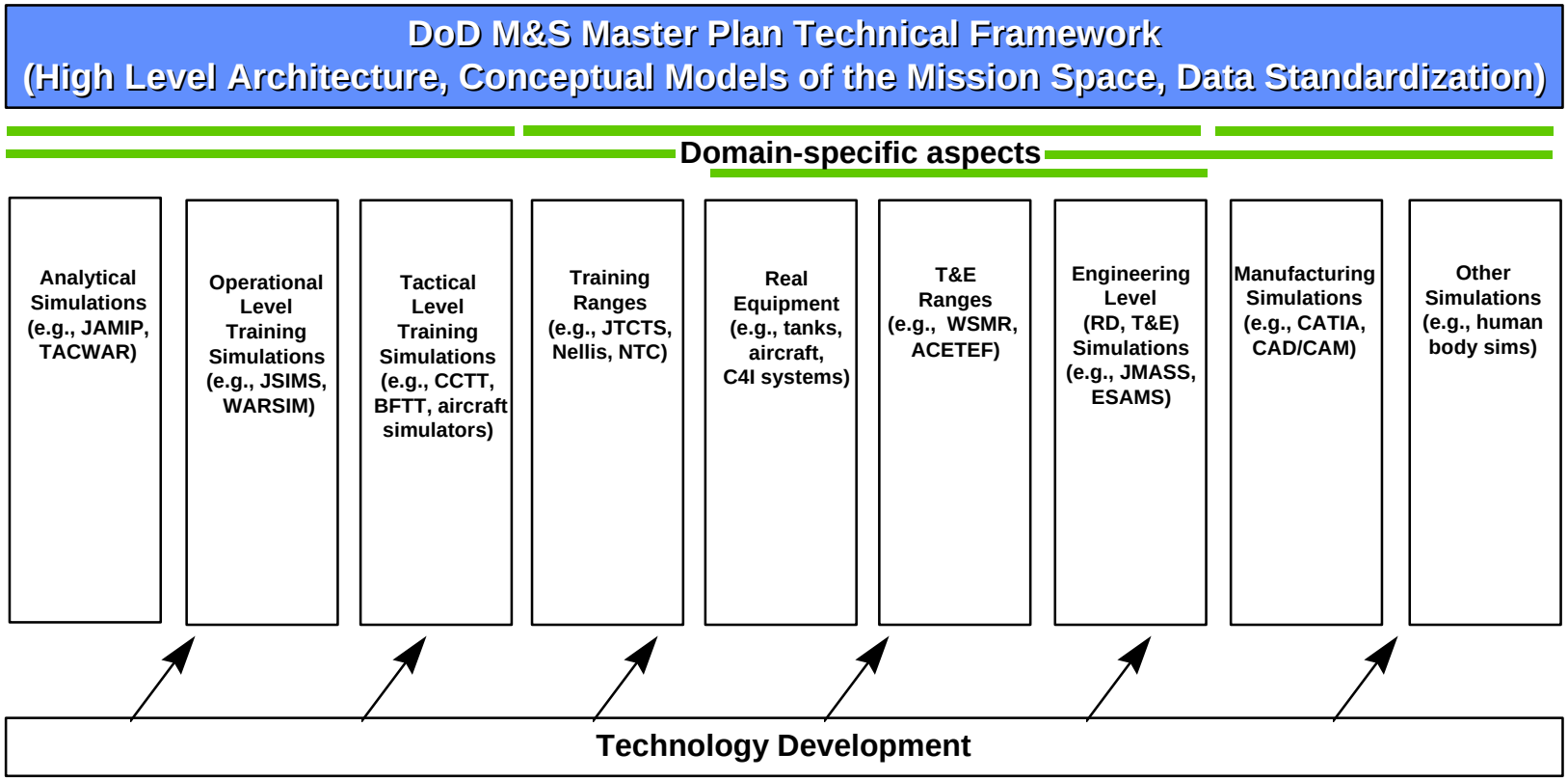
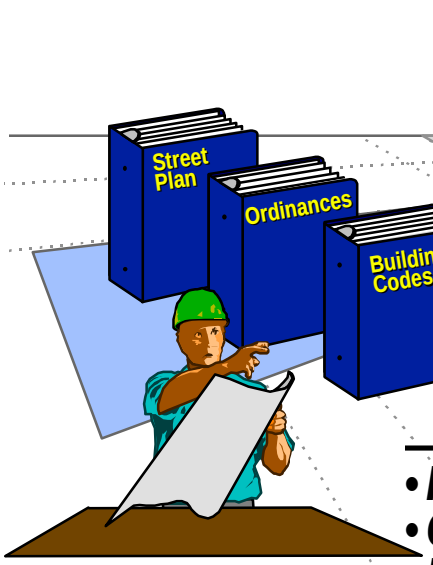
An Overarching Technical Framework



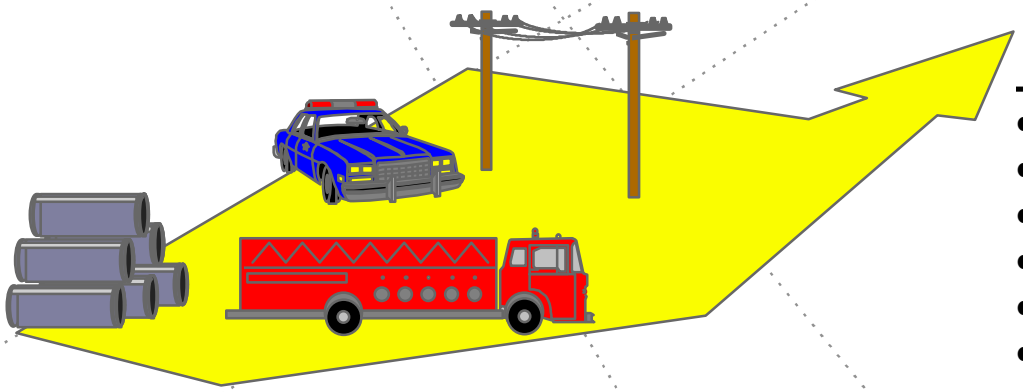
Payoffs: Interoperability and reuse = capability and cost-effectiveness

DoD M&S Strategy: An Analogy to City Planning



Technical Framework

- *High Level Architecture*
- *CMMS (common world view)*
- *Data Standards*

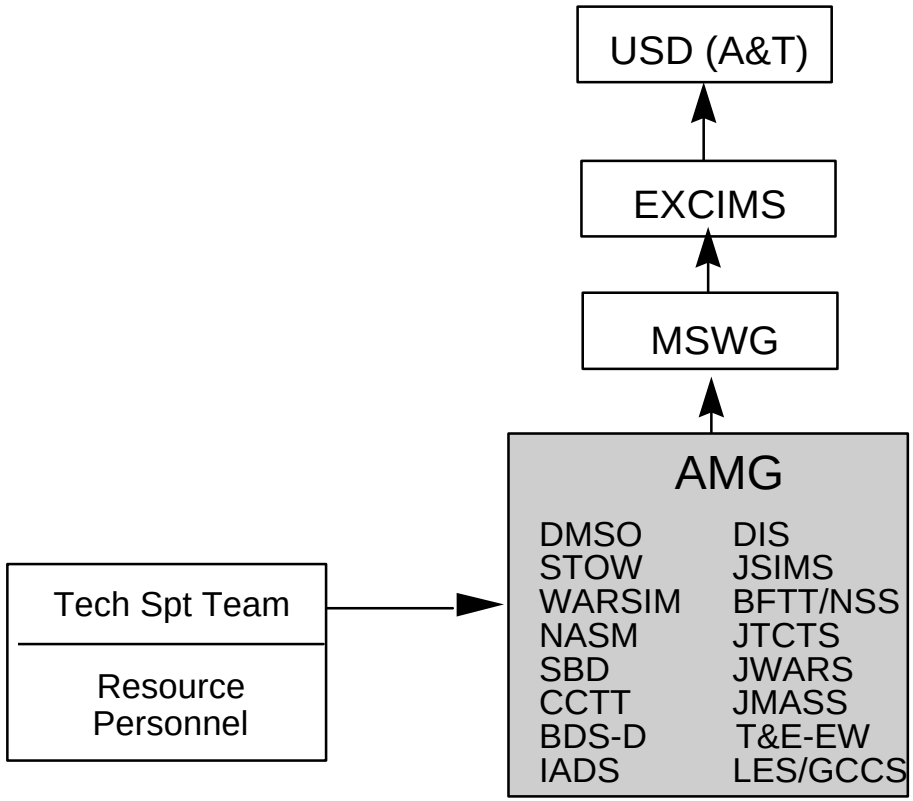


Common Services

- *Communication networks*
- *Environmental databases*
- *Resource repositories*
- *VVA policy and procedures*
- *Help Desks (MSOSA/IAC)*
- *Supporting software/tools*

Payoffs: Interoperability and reuse = capability and cost-effectiveness

HLA Evolving through an Integrated Product Team Structure



MSWG
Modeling and Simulation Working Group (0-6)

AMG
Architecture Management Group

Approximately 240 players total:

(Baseline)	35%	government
	12%	FFRDC
	5%	academia
	48%	industry

Premise for HLA Evolution

- **Changes/enhancements should be based on issues raised by users of HLA**
- **Changes need to be evaluated in terms of benefits and impacts on the HLA user community**
- **AMG is the focus for evolution including identifying issues, evaluating options for addressing the issues, and approving changes**
- **As other programs begin implementation of HLA, they will be represented in the AMG process**

Five Step HLA Evolution Process

- **Step 1**
  - **An AMG member expresses a need for a capability, options for meeting that need, and generality of need areas**
- **Step 2**
  - **A summary issue paper and investigation plan is developed, and issue team is formed to conduct investigation**
- **Step 3**
  - **Plan is executed, tech exchanges are conducted to review technological progress and issues, with status updates given at AMG meetings**
- **Step 4**
  - **Recommended changes to HLA spec are drafted, integrated across specifications, and reviewed by AMG technical community**
- **Step 5**
  - **AMG reviews recommended changes**

Regular HLA Checkpoints

- Six month cycles will serve as routine checkpoints in the HLA process
- At least one month prior to each checkpoint
  - Progress of issue investigations will be checked
  - Proposed changes in architecture and impact on specification will be evaluated
  - Draft changes in specifications will be prepared for AMG review
- Changes are drafted and integrated across the specifications
- Checkpoints also provide timing for externally motivated changes in specifications (e.g. text updates, deleting parameters)
  - Specs have comment forms; these will be maintained by DMSO and coordinated via the TST

First Checkpoint was February 1997

HLA Supporting Software and User Services

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HLA Supporting Software

- **HLA is an architecture, not software -- however, to facilitate cost-effective implementation of HLA, DMSO is developing an initial suite of HLA supporting software**
- **Suite will include versions of the Runtime Infrastructure software as well as Object Model Support Tools**
- **HLA Supporting Software is**
  - **Open distribution in the public domain**
  - **Open access to specifications (e.g., Object Model Template data interchange format) to foster development of commercial software in support of HLA**
  - **Supported by ongoing SBIR initiatives among several DoD agencies to develop additional tools for the HLA support suite**

HLA Supporting Software:
Runtime Infrastructure (RTI) Software

- **RTI software is available now and can be ordered from DMSO homepage (http://hla.dmso.mil) under topic "HLA Software Distribution Center"**
- **User defines own account name and password**
  - **User account approved following one-time submission of registration data**
  - **Approved users may access and download any products not previously downloaded**
  - **Currently six ports for RTI are available**
    - **Each port includes RTI software; Installation guide; User documentation; Test federate; Sample applications**
  - **Once registered you will be automatically notified of new releases**
- **RTI version 1.0 out now, version 1.3 in March 98**
- **RTI version 2.0 commercial procurement underway; out late 98 (TBD)**

HLA Supporting Software:
Object Model Support Tools

- **Object Model Development Tools (OMDTs)**
  - **Automated support for development HLA Object Models (OMs), generation of RTI federation execution data, and exchanging OMs with the Object Model Library**
- **Object Model Library (OML)**
  - **Web-accessible library for storing and retrieving completed HLA object models (SOMs and FOMs)**
- **Object Model Data Dictionary (OMDD)**
  - **An automated catalog of data elements for use in HLA object models**
- **Initial public release of OM tools began October 1997**
  - **Currently one OMDT and access to OML available, same as RTI**
- **Next release is March 1998; versions compliant with HLA Specification 1.3**

HLA User Services

- **DMSO is fostering a broad range of User Services to facilitate the HLA transition**
  - **DMSO HLA Home Page**
  - **HLA Help Desk**
  - **HLA Technical Library**
  - **HLA Education/Outreach**
  - **HLA Compliance Testing**

HLA User Services:
DMSO HLA Home Page

- **HLA home page has been reorganized to accommodate the new sets of materials and broader user community**

http://hla.dmso.mil

HLA User Services:
HLA Help Desk

- DMSO established a specialized MSOSA cell for HLA in May 97
- Focal point for inquiries to DMSO on HLA
- hla@msis.dmso.mil e-mail goes to the HLA Help Desk
  - Directly responds to general inquiries
  - Refers
    - Training requests
    - Policy questions
    - RTI-specific technical questions
  - Logs and tracks
- Increasing level of activity

HLA User Services:
HLA Technical Library

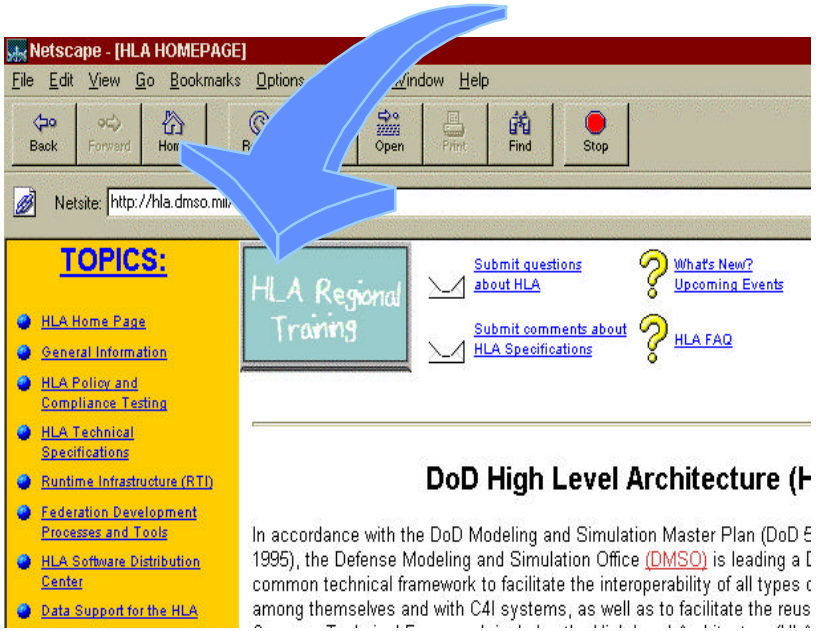
- **DMSO has established an online "public library" for the M&S community, available through the DMSO HLA Web page**

http://hla.dmso.mil

  - **HLA Baseline Definition (Rules, Interface Specification, Object Model Template) -- access under the Left Frame Option "HLA Technical Specifications"**
  - **HLA Glossary -- access under the Left Frame Option "General Information"**
  - **Interface Specification Supporting Documents (Test Procedures, Time Management, API) -- access under the "Interface Specification" hotlink through the Left Frame Option "HLA Technical Specifications"**
  - **OMT Supporting Documents (OMT Extensions, Test Procedures) -- access under the "Object Model Template Specification" hotlink through the Left Frame Option "HLA Technical Specifications"**
  - **HLA Compliance Checklist -- access under the Left Frame Option "HLA Policy and Compliance Testing"**
  - **HLA Federation Development Process Model -- access under the "Federation Development Process" hotlink through the Left Frame Option "Federation Development Processes and Tools"**
  - **HLA Security Architecture -- access under the "Federation Development Process" hotlink through the Left Frame Option "Federation Development Processes and Tools"**
  - **Additional briefings and documents -- access under the Left Frame Option "Published Papers"**

HLA User Services:
HLA Education/Outreach

- **Integrated DMSO HLA training/outreach program is underway**
  - **No cost to recipients other than TDY costs**
  - **Sign-up through HLA home page http://hla.dmso.mil**



- **Continually evolving HLA training offerings to respond to different training needs**
  - **Regional -- Comprehensive introduction to HLA offered monthly**
  - **Focused Training -- Half day focused sessions as adjuncts to Regionals or standalone offerings**
    - **HLA Federation Development and Execution**
    - **Adapting Your Simulation to Use HLA**
    - **Use of Automated Tools to Support HLA Object Model Development**
    - **HLA Compliance Testing**
  - **Hands-on Practicum -- twice a month offerings for implementer-level training in use of HLA**

- **DoD M&S Staff Officer's Course addresses HLA in the context of overall M&S familiarization -- apply through DoD MSSOC hotlink on DMSO Home Page at http://www.dmso.mil**

HLA User Services:
HLA Compliance Testing

- **FY97 achievements**
  - **Developed a process for testing federates for HLA compliance**
  - **Developed first integrated set of automated & semi-automated test tools to manage and implement the test process**
  - **Tested the test process and tools on "friendly victims"**
- **Compliance testing approach:**
  - **Straightforward, over the network**
  - **Minimal effort required by federate**
  - **A semi-automated Test Management System**
    - **Documented test process in easy-to-use guide: procedures, sizes, submission formats, examples, etc.**
    - **Web-based, on-line test preparation (for federates) and test management (for certification authority), integrated with test tools**
    - **Testing capability placed in operation 31 October 1997**
- **Test applications continue to increase; several certifications have been completed!**

HLA and External Standards

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HLA in Related Standards Efforts

- **HLA is being promulgated as part of broader standards:**
  - **DoD Joint Technical Architecture (JTA)**
  - **North Atlantic Treaty Organization (NATO)**
  - **Simulation Interoperability Standards Organization (SISO) - for IEEE standardization**

JTA 2.0

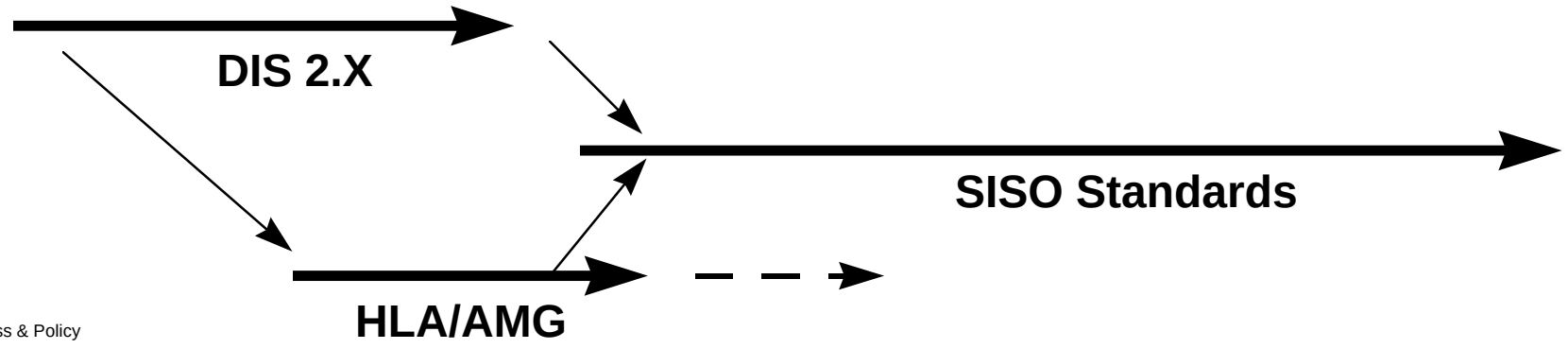
- **Restructured to provide for inclusion in the future of other kinds of standards beyond information technology: electrical, mechanical, etc.**
- **Begins expansion beyond C4I domain. A series of expansions is to establish a set of "open system building codes" for weapon systems and other areas.**
- **Adds annexes for three subject areas not included in JTA Version 1.0**
  - **Airborne Reconnaissance**
  - **Automatic Test Equipment**
  - **Modeling and Simulation, including HLA**
- **Draft JTA 2.0 has been through initial review; will be re-released again soon for further coordination**
- **JTA 2.0 is scheduled for release in March 1998**

NATO Steering Group on M&S Objectives

- **Formed in November 1996 to craft an Alliance approach to achieve simulation interoperability and reuse**
- **Major Activities**
  - **Develop a preliminary NATO M&S Master Plan, using the U. S. approach as a baseline and conducting "excursion analyses" to accommodate the NATO environment**
  - **Draft a roadmap to achieve prioritized NATO simulated environments**
  - **Recommend NATO policies regarding M&S management**
  - **Present a final report with the above products by Fall 1998**
- **13 nations active; detailed Programme of Work set**
- **HLA Technical Workshop in the Hague, 8-10 July 1997**
  - **Over 90 national simulation experts in attendance**
  - **DMSO provided HLA technical experts**
  - **Demonstrated HLA implementations**
- **Consensus emerging the HLA is the right technical architecture to support interoperability and reuse**

HLA Supporting Standards

- **Important that HLA be integrated into broader, industry based technical community**
  - **Many HLA concepts/goals were birthed within DIS/IEEE workshop**
  - **HLA development supports achievement of the DIS Vision**
  - **DIS players are deeply involved in HLA development**
  - **The Simulation Interoperability and Standards Organization (SISO) (successor to the DIS Workshop) is the desired venue for establishment of HLA supporting standards**
  - **HLA has been nominated as an IEEE standard**



SISO/IEEE Standards

- **In May, an HLA standards nomination was submitted by DMSO to the SISO Standards Activity Committee for IEEE standardization**
- **Standards Activity Committee (SAC) process is underway**
  - **Initial review successfully completed**
  - **SISO Executive Committee approved the standard nomination in September**
  - **The responsible Standards Development Groups will begin to meet in October**
- **DMSO and AMG members will actively support the process**
- **Anticipate three IEEE standards (HLA Rules, I/F spec, OMT) in summer/fall 1999**
- **AMG will evaluate, make recommendation on adoption to EXCIMS**

Back-Up Slides

EXCIMS

DDR&E (Chair)

ASD(C^3I)

DUSD(R)

OSD/PA&E

ASD(ES)ICA

DTSE&E

Joint Staff, J-7

Joint Staff, J-8

Army

Navy

Air Force

Marine Corps

Intelligence Community

MSWG

DMSO (Chair)
OUSD (P&R)
ODTSE&E
OASD (C3I)/CISA
OSD/PA&E
ASD (ES)/DASD(IA)
OASD (RA) (RT&M)
Joint Staff, J-6
Joint Staff, J-7
Joint Staff, J-8
HQ DCSOPS DAMO-ZS
OPNAV, N6M
U.S. Air Force
MCMSMO/MCCDC
DARPA
BMDO
NSA
DISA/D-8
DMA
DSWA
JWFC
DMA(TMPO)
AFCCC
NRL
DIA
JSF/MSA

AMG Representatives

Defense Modeling and Simulation Office (Chair)
Synthetic Theater of War
Joint Simulation System
Warrior Simulation for the Year 2000
Battle Force Tactical Trainer
National Air and Space [Warfare] Model
Joint Tactical Combat Training System
Simulation Based Design
Close Combat Tactical Trainer
Joint Warfare System
Joint Modeling and Simulation System
Test & Evaluation/Electronic Warfare
Integrated Air Defense Simulation
Leading Edge Services/Global Command and Control System
Battlefield Distributed Simulation-Developmental
Joint Advanced Distributed Simulation Joint Test Facility
Joint National Test Facility
Mobility Analysis Support System
Joint Simulation System-Maritime
Ventronics Simulation Facility
Computer Aided Modeling and Equipment Evaluation
Modeling, Analysis & Simulation Center
Naval Simulation System
Joint Virtual Laboratory
Distributed Mission Training
Virtual Proving Ground

HLA Compliance

- **HLA compliance checklist has been developed**
- **Testing Working Group has defined testing procedures for the interface specification and the OMT. These guide HLA compliance testing.**
- **By June FY97, Services must bin simulations into three categories:**
  - **HLA-compliance actions initiated immediately**
  - **HLA-compliance actions initiated at a specific future date**
  - **No HLA-compliance planned (thus requiring eventual retirement or a waiver)**
- **Timetable for Implementation**
  - **FY99: no more development of non-compliant simulations**
  - **FY01: no more use of non-compliant simulations**